ROYAL ASTRONOMICAL SOCIETY.

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Capt. W. H. SMYTH, R.N., Vice-President, in the chair.

The nineteenth volume of the *Memoirs* is now ready for delivery. The price is 6*s.* to Fellows of the Society, and 12*s.* to the Public. Vol. X. of the *Monthly Notices*, which contains the Observations, shorter and less abstruse Memoirs, Abstracts, Lectures, &c., is *given* to purchasers of the 4to. volume.

The two publications are supplementary to each other, and are to be considered as parts of the same series. They contain scarcely anything in common, except the Annual Report, and between them include a complete account of the proceedings of the Society during the year. The low price of this volume is due to the liberality of the Board of Admiralty, who have paid the expense of computing and printing "Fallows' Observations." The Astronomer Royal has given the necessary instructions for performing this work, and discharged the duties of Editor.

"*Memoirs, Astronomical and Geodesical*, by Mr. Maclear, Her Majesty's Astronomer at the Cape of Good Hope," forming part of the 4to. volume, No. XX., have been printed, and are ready for distribution. These memoirs have been printed principally at the expense of the Board of Admiralty. Gentlemen who wish to possess them before the publication of the volume should apply to the Council of the Royal Astronomical Society.

IRENE.

Discovery of Irene. By Mr. Hind.

"On May 19th, at $12^h\ 58^m$ mean time, I discovered another small planet near the star numbered 29490 in the reduced catalogue of the *Histoire Céleste*. A star a little north, and following Lalande's, is omitted upon Wölfer's chart (Hora xvi.), and my attention having been thereby directed to this part of the heavens some years since, I knew that an object so bright as the planet could not have escaped notice, and, accordingly, compared it at once with Lalande's star, with the aid of the wire-micrometer. At $16^h\ 39^m$ the new star followed L. 29490 by $8^s{\cdot}3$, and at $16^h\ 52^m$ the difference of right ascension was $7^s{\cdot}7$, quite sufficient to establish motion in one object. At $17^h\ 15^m$ the difference of right ascension was $6^s{\cdot}6$. The planetary nature of the stranger was, therefore, satisfactorily proved from 36^m interval; and a reference

to the ephemerides of the newly-discovered planets, published in the *Nautical Almanac* and *Berliner Jahrbuch*, showed that all of them were differently situated, and that I had been fortunate enough to discover another new planet.

"Sir John Herschel has selected *Irene* for the name of this planet: the symbol to be a dove with olive-branch and star on head.

"At the time of discovery, the brightness of *Irene* was rather over that of a star of the ninth magnitude. Her light is very blue, and she appears to be surrounded with a faint nebulous envelope not perceptible about the stars in her vicinity."

Observations.

South Villa. Equatoreal. (MM. Bishop and Hind.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
May 19	13 9 36	16 4 9·61	103 23 36·3
21	11 15 39	16 2 14·16	103 26 23·1
23	11 13 48	16 0 13·67	103 29 42·9

Greenwich. Meridian Circle. (Astronomer Royal.)

1851.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
May 28	11 31 38·3	15 55 15·16	103 39 10·0
29	26 44·2	54 16·87	41 15·2
30	21 51·1	53 19·64	43 23·2
31	16 58·6	52 22·77	45 40·0
June 2	11 7 15·7	50 31·38	50 24·1
4	10 57 36·6	15 48 43·88	103 55 21·1

Not corrected for parallax.

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
May 26	11 53 22·1	15 57 11·82	Mer.	103 35 14·1	−9·9624	γ Libræ
	12 33 14·3	10·21	+7·852	19·4	·9614	—
27	10 30 41·0	15 56 16·48	−8·136	103 37 4·2	·9586	—
	11 10 33·6	14·73	−7·830	8·8	·9615	—
	11 48 26·5	13·13	Mer.	13·3	·9626	—
28	10 37 45·1	15 55 17·14	−8·066	103 39 9·0	·9598	—
	11 11 38·9	15·86	−7·756	10·7	·9620	—
	11 45 32·3	14·33	+6·554	13·9	·9627	—
30	10 23 58·8	15 53 22·10	−8·086	103 43 21·5	·9597	—
	10 58 52·2	20·43	−7·807	25·2	·9621	—
	11 33 45·9	18·95	Mer.	27·1	·9629	—
31	10 19 5·5	15 52 25·25	−8·086	103 45 34·5	·9598	—
	10 53 59·1	23·74	−7·806	38·4	·9622	—
	11 28 52·7	22·24	Mer.	41·0	−9·9630	—

The observations are corrected for refraction. The corrections to be applied

for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax.

The following is the assumed *mean* place of the star of comparison for 1851·0, derived from the Greenwich 12-year Catalogue:—

	R.A.	N.P.D.
	h m s	° ′ ″
γ Libræ	15 27 11·83	104 17 19·49

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

1851.	Green. M.T.	R.A.	Log $\frac{p}{P}$	N.P.D.	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s		° ′ ″				
May 21	11 0 5·2	16 2 15·06	−8·076			5		(*a*)
	12 5 41·8	11·99		103 26 28·5	−9·9580	Mer.		
	12 17 58·3	11·92	+7·354	103 26 28·6	−9·9579	9	9	(*a*)

The star (*a*) is Bessel (Weisse), xvi. 38, and Weisse's place is adopted. Mr. Breen readily detected the planet by its blue colour.

DURHAM. Fraunhofer Equatoreal. (Professor Chevallier.)

1851.	Greenwich M.T.	App. R.A.	Log $\frac{p}{P}$	App. N.P.D.	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Set.
	h m s	h m s		° ′ ″				
May 22	11 53 0·6	16 1 12·17	−7·373	103 28 11·7	−9·9662	20	4	1
26	8 7·4	15 57 14·92	−7·838	35 12·1	9·9657	14	4	2
31	11 28 43·3	15 52 22·48	+5·...	103 45 39·3	−9·9672	18	6	3

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Greenwich M.T.	App. R.A.	Log $\frac{p}{P}$	App. N.P.D.	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Set.
	h m s	h m s		° ′ ″				
May 22	10 40 22·7	16 1 15·12	−8·168	103 28 5·0	−9·9620	12	4	1
26	11 0 56·8	15 57 15·07	−7·905	35 12·5	9·9654	21	7	2
28	10 22 22·6	55 18·73	−8·810	39 7·8	9·9633	24	8	3
	11 28 54·9	15·39	−7·207	10·9	9·9669	18	6	4
29	12 4 13·7	54 15·57	+7·730	41 18·6	9·9664	24	8	5
30	11 32 59·6	53 19·65	+5·000	43 25·8	9·9666	6	2	6
31	10 34 52·6	52 24·54	−7·922	45 35·2	9·9659	21	7	7
June 4	10 38 0·9	48 44·33	−7·644	55 16·5	9·9673	24	8	8
	11 11 34·3	43·14	+5·550	20·0	9·9678	15	5	9
5	10 26 11·4	15 47 52·16	−7·751	103 57 52·8	−9·9675	24	8	10

P is the Eq. Hor. Parallax in seconds of arc; p and q the required corrections in seconds of time and arc respectively.

Mean Places of Stars of Comparison.

	h	h m s	° ′ ″	Set.
Weisse xv,	1144	15 59 51·85	103 32 2·1	1
—	1118	58 46·01	40 0·3	2, 3
48 Libræ		49 51·08	50 41·7	4 to 8, and 10
Weisse xv,	910	15 47 53·46	103 57 23·5	9

By one transit the R.A. of Weisse xv, 1118 would seem to be more correctly . . . 45ˢ·20. The stars used by Professor Chevallier were the same as Mr. Carrington's, on the same nights.

May 26. Sky very hazy.
28. Very favourable.
29. Much vapour. Objects furred and unsteady.
30. Two indifferent comparisons. Clouds interrupted.
June 4. A small star, 10th mag., very near the planet, s. p. Sky more or less foggy on this night also.
5. The planet s.p. of Weisse xv, 910, and very close to it. The result of this set should be good, as all circumstances were particularly favourable.

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Decl. (not Corrected for Parallax.) ° ′ ″	
May 24	10 39 0·7	239 49 12·8	−13 31 36	
	11 51 26·2	48 23·6	30·2	Mer. Circle.
26	10 25 51·3	239 19 24·6	35 2·8	
	11 41 36·0	.....	20·3	Mer. Circle.
27	10 16 13·3	239 4 44·1	36 59·8	
	11 36 40·8	3 50·8	75·2	Mer. Circle.
28	10 25 46·4	238 49 26·4	39 4·0	
	11 31 46·5	49 11·4	9·3	Mer. Circle.
30	13 26 42·6	238 19 7·7	43 30·2	
31	10 19 27·2	238 6 42·6	45 29·8	
	11 17 6·6	6 3·5	38·8	Mer. Circle.
June 1	10 16 22·0	237 52 42·2	−13 47 53·3	
	11 12 14·4	51 58·1	54·3	Mer. Circle.

Apparent Places of Compared Stars observed with Mer. Circle.

		R.A. h m s	° ′ ″
May 24	*a*	15 59 53·581	−13 32 3·9
31	*b*	58 46·839	40 1·5
	♆ Lib.	15 49 52·719	−13 50 43·7

Circular Elements.

By Mr. N. Pogson, Junior Assistant at Mr. Bishop's Observatory.

$r = 2{\cdot}45945$

	° ′	° ′
☊	83 37·71	I 10 42·36
Arg. of Lat. at Epoch	156 18·89	
Daily Motion in Orbit.....	15·695	

Epoch, May 19·54833

Mr. Pogson contributed an Ephemeris, which has been forwarded to several observatories for immediate use.

Elliptic Elements. By MM. Vogel and G. Rümker, from Mr. Hind's observation May 19, and the observations made May 24 and May 31.

May 24·0 M.T. at Berlin.

M	42° 4′ 48″·98	
π	183 54 29·82	Mean Equinox, Jan. 0·1851.
Ω	87 58 59·38	
I	8 34 42·98	
φ	9 46 35·5	
Log e	9·2299526	
Log a	0·4070989	
Log μ	2·9393582	

The calculation agrees with the middle observations in longitude as well as in latitude.

Ephemeris. By MM. Vogel and G. Rümker.

10^h Berlin Mean Time.

	R.A. h m s	N.P.D. ° ′	Log. Δ.
June 1	15 51 31	103 47·8	0·10934
2	50 35	50·2	
3	49 40	52·7	
4	48 47	55·2	
5	47 55	103 57·8	0·11511
6	47 4	104 0·5	
7	46 13	3·3	
8	45 24	6·2	
9	44 36	9·1	0·12202
10	43 50	12·1	
11	43 6	15·2	
12	42 22	18·4	
13	41 40	21·7	0·12998
14	40 59	25·0	
15	40 20	28·5	
16	39 43	32·0	
17	39 7	35·5	0·13889
18	38 32	39·1	
19	38 0	42·9	
20	37 29	46·7	
21	36 59	50·6	0·14863
22	36 32	54·6	
23	36 6	104 58·7	
24	35 42	105 2·8	
25	35 20	6·9	0·15908
26	35 0	11·2	
27	34 41	15·5	
28	34 23	19·9	
29	34 8	24·3	0·17011
30	33 55	28·8	
July 1	33 44	33·4	
2	33 34	38·0	
3	15 33 26	105 42·7	0·18161

ASTRÆA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Comp^{n}—Obs^{n}. R.A. s	N.P.D. ″
May 12	9 59 9·1	14 23 30·57	95 0 42·4	+5·29	+24·0
	10 24 4·5	29·74	38·9	5·31	24·3
	10 48 59·9	28·90	35·2	5·33	25·0
	11 13 55·4	28·17	31·8	5·23	25·3
13	10 32 20·2	14 22 42·79	94 57 44·4	5·35	26·5
	10 52 16·4	42·23	41·9	5·27	26·7
	11 12 12·6	41·43	39·9	+5·43	+26·4

The parallax and computed places were deduced from the ephemeris contained in the Supplement to the *Nautical Almanac*, 1854.

The star of comparison for all the observations was *μ Virginis*.

The following is the assumed *mean* place for 1851·0 derived from the Greenwich Observations:—

	R.A. h m s	N.P.D. ° ′ ″
μ Virginis	14 35 12·80	95 0 26·05

METIS.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

Set.	1850.	Green. M.T. h m s	App. R.A. h m s	Exc. of Ephem. s	App. N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Com. in R.A.	No. of Com. in N.P.D.
1	Dec. 23	15 36 58·2	10 2 50·44	...	70 35 18·9	...	18	6
2	27	14 27 30·6	3 17·25	...	70 19 51·3	...	24	8
	1851.							
3	Jan. 6	13 29 15·9	1 58·08	...	69 29 7·3	...	12	4
4	7	14 38 16·9	10 1 37·80	...	69 22 53·5	...	18	6
5	Feb. 8	10 50 11·1	9 36 37·13	−3·48	65 49 21·8	+6·4	18	8
6		12 28 50·6	32·76	3·42	...	...	meridian	
7	14	13 23 5·1	30 16·16	3·44	65 17 28·4	5·5	24	8
8	16	14 50 39·5	28 10·50	3·03	65 8 15·3	8·6	21	7
9	17	10 45 36·5	27 20·83	3·01	65 4 51·8	5·3	24	8
10	17	11 44 14·8	27 18·68	3·28	65 4 35·4	11·8	meridian	
11	20	13 31 7·6	24 19·70	3·14	64 53 10·3	8·9	24	8
12	21	12 54 37·3	23 25·03	3·34	64 49 57·3	9·2	16	8
13	23	12 47 50·8	21 36·23	−3·26	64 44 7·1	+4·4	11	4
14	Mar. 4	9 11 30·1	14 41·24	...	64 28 30·3	...	14	5
15	10	12 19 29·3	9 11 11·42	...	64 27 38·2	...	24	8

1850, Dec. 27. Wind loud, and sky unsettled.

1851, Jan. 6. Fog prevented further comparisons. γ', the brighter star of γ *Leonis* was used.

Feb. 8. Set 5. R.A. and N.P.D. measures taken separately.
Set 6. Observed with difficulty on the meridian.

Feb. 17. Set 9. Measures very satisfactory, but star indifferent.
Set 10. Meridian. N.P.D. probably indifferent.

Feb. 23. Star in a difficult position. Interrupted by fog.

The above observations are corrected for refraction and parallax, and compared with the ephemeris circulated by Lieutenant Stratford, so far as that ephemeris extends.

Mean Places of the Stars of Comparison used at Durham, and of certain other stars near the path of *Metis*, during the opposition of 1850–1, observed on the meridian at Durham : *—

Set.	Name.	Mag.	R.A. (1851·0). h m s	N.P.D. ° ′ ″	No. of Obs.
	(*a*)	8	9 4 53·57	65 5 48·2	1
14, 15	Lalande 18184	6	5 46·60	64 22 27·9	3
	Lalande 18259	9	8 5·83	64 44 40·4	3
	Lalande 18482	8	15 43·66	65 47 4·8	1
	(*b*)	9	16 36·45	64 37 39·6	3
13	(*c*)	8	21 30·35	64 40 15·8	3
11, 12	(*d*)	9	22 55·32	64 55 56·5	2
9	(*e*)	10	28 9·88	65 2 6·4	†
	(*f*)	8	29 2·60	64 56 11·9	3
7, 8	(*g*)	9	29 24·70	65 15 59·4	2
5	B.A.C. 3327	7	36 47·17	65 50 32·8	2
	Lalande 19329	8	44 27·84	66 40 56·1	5
	Lalande 19522	7	51 9·92	67 58 10·0	4
	B.A.C. 3423	7	54 30·00	67 20 1·9	1
4	Lalande 19677	9	9 56 55·60	69 21 50·7	2
2	(*h*)	9	10 0 3·24	70 30 30·5	2
1	B.A.C. 3460	7	0 57·40	70 44 21·4	2
	Lalande 19900	9	6 58·83	70 8 16·8	1
3	γ' Leonis	2	10 11 45·05	69 24 25·4	4

BIELA'S COMET.

Extract of a Letter from Professor Santini of Padua to the Astronomer Royal.

" 1851, *April* 3.

" Some time ago, I took the liberty of sending you the elements of the periodic comet of Biela for 1852, in which I had included the effect of the perturbations depending on *Jupiter* and *Saturn*. I have subsequently calculated the alterations depending on the earth and *Venus;* I have not, however, thought it necessary to take notice of those produced by *Mars*, both on account of the smallness of its mass, and because, during the revolution from 1846 to 1852, it is always at a great distance from the comet. The values of the alterations produced by *Jupiter*, *Saturn*, the earth, and *Venus* (ac-

* " Star (*a*) was kindly observed for me at Cambridge by Mr. Breen.

† " The place of Star (*e*) depends on a single comparison with (*f*) ; it was too faint for the transit. The other stars were observed during February last, and would have been based on more observations had I not been suddenly suspended from work by illness. The corrections to *Nautical Almanac* stars, at present in use at Greenwich, were applied throughout in finding clock-error.

" I should state, in reference to the star-observations, that I find the average error of a single observation of a *Nautical Almanac* star, with the Durham transit-circle, to be in R.A. $\pm$ 0ˢ·05, and in N.P.D. $\pm$ 1″·0, the circle being small. The N.P.D.s are obtained differentially from *Nautical Almanac* stars, the *zero* of the circle being too unstable for independent measures of *zenith* distance."

cording to my results), will be inserted in an article of the *Astronomische Nachrichten*, which, since the melancholy decease of our veteran colleague Schumacher, are continued by Mr. Petersen; I therefore take the liberty of sending you the elements last obtained, with the addition of the alterations depending on the earth and *Venus*, accompanied with an ephemeris for the search of the comet at its next appearance, which I hope will prove sufficiently exact. I have not thought it advisable to continue it beyond September 30, because it will be necessary to correct the elements after the first observations, and then a new ephemeris founded on the corrected elements may be more convenient.

Elliptic Elements for the Mean Equinox of 28 September, 1852.

Perihelion Passage	T =	1852, Sept. 28·68134, Greenwich Mean Time	
Longitude of Perihelion	π =	109 ° 8 ′ 21·49 ″	
— of Ascending Node	ω =	245 52 29·32	
Inclination to the Ecliptic..	i =	12 33 16·56	
Angle of Eccentricity	φ =	49 8 6·36	log e = 9·8786679
Daily Sidereal Motion	n =	534″·813993	log a = 0·5478692

" In the calculation of the ephemeris, the following constants have been adopted :—

" 1. In the computation of the true anomaly v and radius vector r, by means of the eccentric anomaly E, from the equations

$$\sin \frac{v}{2} \cdot \sqrt{r} = A \sin \frac{E}{2}$$

$$\cos \frac{v}{2} \cdot \sqrt{r} = B \cos \frac{E}{2}$$

I have used log A = 0·3962283, log B = 9·9674029.

" 2. For the calculation of the right ascensions and the geocentric declinations referred to the true equinox, the values of the solar co-ordinates referred to the equator are taken from the *Nautical Almanac*, 1852; and the heliocentric co-ordinates of the comet referred to the plane of the equator, measured from the true equinox, are computed by means of the following formulæ :—

$x = m.r \sin (v + M)$; $y = n.r. \sin (v + N)$; $z = p.r. \sin (v + P)$;

the constants m, n, p, M, N, P, deduced from the elements above, being given by the following table :—

1852.	M.	Log m.	N.	Log n.
	° ′ ″		° ′ ″	
June 30	198 36 34·7	9·9912824	104 51 57·2	9·9785000
Aug. 29	36 43·7	·9912819	52 5·3	·9784978
Oct. 28	36 49·8	·9912817	52 11·4	·9784961
Dec. 27	198 36 59·6	9·9912813	104 52 20·0	9·9784957
	P.	Log p.		
	° ′ ″			
June 30	139 37 53·8	9·5629343		
Aug. 29	38 0·3	·5629502		
Oct. 28	38 5·8	·5629585		
Dec. 27	139 38 14·3	9·5629684		

Ephemeris of the Comet of Biela, referred to the true Equinox.

Greenwich Mean Noon.

1852.	Geocentric R.A. of Comet.	Difference.	Geocentric Decl. of Comet.	Difference.	Log. Dist. from the Earth.
	° ′ ″	° ′ ″	° ′ ″	′ ″	
June 30	42 27 7·8	+3 24 50·3	+24 16 34·4	+43 36·9	0·29872
July 4	45 51 58·1	3 35 25·6	25 0 11·3	40 30·5	0·28516
8	49 27 23·7	3 46 38·5	25 40 41·8	36 36·9	0·27157
12	53 14 2·2	3 58 22·3	26 17 18·7	31 49·5	0·25797
16	57 12 24·5	4 10 27·4	26 49 8·2	26 0·8	0·24449
20	61 22 51·9	4 22 42·0	27 15 9·0	19 5·2	0·23125
24	65 45 33·9	4 34 54·5	27 34 14·2	10 58·1	0·21832
28	70 20 28·4	4 46 48·1	27 45 12·3	+ 1 37·4	0·20583
Aug. 1	75 7 16·5	4 57 52·2	27 46 49·7	− 8 56·8	0·19593
5	80 5 8·7	5 7 48·2	27 37 52·9	20 39·0	0·18277
9	85 12 56·9	+5 16 9·9	27 17 13·9	−33 20·2	0·17350
13	90 29 6·8		+26 43 53·7		0·16326
Aug. 13	90 29 6·8	+2 40 37·8	+26 43 53·7	−21 39·2	0·16326
15	93 9 44·6	2 41 56·7	26 22 14·5	25 4·1	0·15909
17	95 51 41·3	2 42 59·1	25 57 10·4	28 30·5	0·15523
19	98 34 40·4	2 43 41·4	25 28 39·9	31 57·1	0·15170
21	101 18 21·8	2 44 17·7	24 56 42·8	35 23·4	0·14853
23	104 2 39·5	2 44 25·5	24 21 19·4	38 45·7	0·14572
25	106 47 5·0	2 44 20·7	23 42 33·7	42 3·7	0·14331
27	109 31 25·7	2 44 0·0	23 0 30·0	45 16·1	0·14128
29	112 15 25·7	2 43 25·1	22 15 13·9	48 18·5	0·13965
31	114 58 50·8	2 42 34·8	21 26 55·4	51 13·5	0·13843
Sept. 2	117 41 25·6	2 41 32·3	20 35 41·9	53 56·5	0·13761
4	120 22 57·9	+2 40 16·8	19 41 45·4	−56 28·1	0·13719
6	123 3 14·7		+18 45 17·3		0·13718
Sept. 6	123 3 14·7	+2 38 51·7	+18 45 17·3	−58 46·6	0·13718
8	125 42 6·4	2 37 17·6	17 46 30·7	60 51·2	0·13759
10	128 19 24·0	2 35 34·7	16 45 39·5	62 40·4	0·13836
12	130 54 58·7	2 33 46·2	15 42 59·1	64 15·6	0·13953
14	133 28 44·9	2 31 52·4	14 38 43·5	65 35·2	0·14105
16	136 0 37·3	2 29 53·9	13 33 8·3	66 39·7	0·14292
18	138 30 31·2	2 27 52·4	12 26 28·6	67 29·5	0·14511
20	140 58 23·6	2 25 49·7	11 18 59·1	68 4·4	0·14761
22	143 24 13·3	2 23 46·1	10 10 54·7	68 25·6	0·15042
24	145 47 59·4	2 21 42·1	9 2 29·1	68 33·2	0·15349
26	148 9 41·5	2 19 38·6	7 53 55·9	68 29·2	0·15680
28	150 29 20·1	+2 17 37·8	6 45 26·7	−68 12·5	0·16034
30	152 46 57·9		+ 5 37 14·2		0·16407

FAYE'S COMET.

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

	Green. M.T.	App. R.A.	Log $\frac{p}{P}$	App. N.P.D	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star of Comp.
1850.	h m s	h m s		° ′ ″				
Dec. 25	7 8 7·5	22 18 9·35	+8·475	95 23 50·8	−9·9154	1	1	(*d*)
1851.								
Jan. 5	6 35 25·0	22 40 52·19	8·450	94 9 1·0	9·9116	6	5	(*e*)
22	6 15 9·7	23 18 31·93	8·467	91 43 48·2	9·9027	1	1	(*f*)
	6 40 50·1	35·56	8·509	32·3	9·9018	8	8	(*g*)
24	6 50 55·0	23 12·86	8·528	91 24 11·8	9·9004	6	5	(*g′*)
27	6 58 34·6	30 13·33	8·543	90 54 50·4	9·8986	8	8	(*h*)
Feb. 6	6 51 16·1	23 54 3·45	8·552	89 10 55·3	9·8935	6	6	(*i*)
26	7 20 33·4	0 44 7·24	8·599	85 26 13·0	−9·8875	2	2	(*k*)
Mar. 4	7 35 25·0	0 59 42·09	+8·609			3		(*l*)

P = the equatoreal horizontal parallax in *arc*, p = correction for parallax in R.A. *in time*, q = correction for parallax in N.P.D. in *arc*.

Notes.

Dec. 25. Bad observation. Power 240 was tried: on all other occasions power 166 was used.

Jan. 5. Comet extremely faint: observations difficult and uncertain.

22. Comet very faint: an appearance of a nucleus at times.

24. So faint as to be barely visible.

27. Brighter than on any previous occasion, and easily observed. A slight tendency of the coma to the south-following direction.

Feb. 6. Observations excessively difficult, on account of moonlight. The comet appeared at intervals to have a sparkling nucleus.

26. Comet scarcely perceptible: too near the horizon to be observed satisfactorily.

March 4. Of the last degree of faintness on account of the zodiacal light: could scarcely be observed.

Assumed *Apparent* Places of the Stars.

	App. R.A.	App. N.P.D.	Star and Authority for its Place.
	h m s	° ′ ″	
(*d*)	22 22 40·31	95 34 55·9	Bessel (Weisse) xxii, 478
(*e*)	22 41 16·36	94 10 29·5	— — xxii, 870
(*f*)	23 19 28·04	91 38 15·5	— — xxiii, 389
(*g*)	23 21 7·65	91 39 10·2	Lamont's Zones.
(*g′*)	23 21 7·63	91 39 10·4	— —
(*h*)	23 27 28·21	90 38 2·4	Bessel (Weisse) xxiii, 564
(*i*)	23 55 7·47	88 41 51·4	— — xxiii, 1143
(*k*)	0 43 17·05	85 10 16·2	— — 0, 751
(*l*)	0 58 58·73	84 8 4·2	— — 0, 1044

The star (*g*) was observed four times by Dr. Lamont in the Munich zones: the mean result of the four observations has been used. This star, which was not found in any other catalogue, was estimated by Dr. Lamont to be of the 7·8 magnitude, which appeared to be its magnitude when it was compared with the comet.

On the Vibration of a Free Pendulum in an Oval differing little from a Straight Line. By G. B. Airy, Esq. Astronomer Royal.

" In a paper communicated to this Society several years since, and printed in the eleventh volume of their *Memoirs*, I investigated the motion of a pendulum in the case in which it describes an oval differing little from a circle; and I showed that, if the investigation is limited to the first power of ellipticity, and if α is the mean value of the angle made by the pendulum rod with the vertical, then the proportion of the time occupied in passing from one distant apse to the next distant apse, to the mean time of a revolution, is the proportion of 1 to the square root of $4 - 3 \sin^2 \alpha$. When α is small, this proportion is nearly the same as the proportion of $\frac{1}{2}$ to $1 - \frac{3}{8} \sin^2 \alpha$; or the time of moving from one distant apse to another distant apse is equal to the time of half a revolution divided by $1 - \frac{3}{8} \sin^2 \alpha$. This shows that the major axis of the oval is not stationary, but that its line of apses progresses, and that, while the ellipticity is small, the velocity of progress of the apses is sensibly independent of the ellipticity, and may be assigned in finite terms for any value of the mean inclination of the pendulum-rod.

" This theorem, however, fails totally when the minor axis of the oval is small. It is then found that the velocity of progress of the apses is nearly proportional to the minor axis. But, although the movement of the pendulum in this case may be defined to any degree of accuracy by infinite series, it does not appear that it can be expressed in finite terms of any ordinary function of the time. This is to be expected, inasmuch as, when the problem is reduced to its utmost state of simplicity by making the minor axis = 0, the motion of the pendulum can be expressed only by series. The utmost, therefore, for which we can hope is, to determine the general form of the curve and the rate of progress of its apses, on the supposition that the minor axis is small, in series proceeding by powers of the major axis. This might be so extended as to include higher powers of the minor axis, if it were judged desirable.

" I have thought that an exhibition of the first steps of solution (carried so far as to include the principal multiplier of the first power of the minor axis) might be acceptable to this Society, not purely as a mechanical problem, but more particularly because it bears upon every astronomical or cosmical experiment in which the movement of a pendulum is concerned. The difficulty of starting a free pendulum so as to make it vibrate at first in a plane is extremely great; and every experimenter ought to be prepared to judge how much of the apparent torsion of its plane of vibration is really a progression of apses due to its oval motion."

After a careful analysis of the problem, when the pendulum describes an extremely elongated ellipse, the Astronomer Royal arrives at the following conclusion, which is the principal object of his present investigation. If the length of the pendulum be a,

the semi-major axis of the ellipse described by the pendulum-bob be b, and the semi-minor axis be c, then the line of the apses of the ellipse will perform a complete revolution in the time of a complete double vibration (*i.e.* the time of describing the ellipse) multiplied by $\frac{8}{3}\frac{a^2}{bc}$.

"Thus if a pendulum, 52 feet long (which performs its double vibration in 8 seconds), vibrates in an ellipse whose major axis is 52 inches and minor axis 6 inches, the line of apses will perform a complete revolution *from this cause* in 30 hours nearly.

"If a common seconds pendulum (which performs its double vibration in 2 seconds) vibrates in an ellipse whose major axis is 4 inches and minor axis $\frac{1}{13}$ inch, the line of apses will perform a complete revolution *from this cause* in 30 hours nearly.

"The direction of rotation of the line of apses is the same as the direction of revolution in the ellipse.

"It is worthy of remark, that the expression which is thus found for the progression of the apse on the supposition that the minor axis is much smaller than the major, will, if we make in it c very nearly equal to b, correspond exactly to the formula cited in the beginning of this paper, as found by an accurate investigation when the ellipse approaches very near to a circle. It appears, therefore, very probable that, while b is moderately small, the expression for the progression of the apses is true for all values of c up to b.

"Although the principal object of this paper, as mentioned in the beginning, was to point out how far an apparent rotation of the plane of a pendulum's vibration may depend on causes which would exist if the suspension were perfect, and if the point of suspension were unmoved and the direction of gravity invariable, still it may not be uninteresting to point out how an effect, in some respects similar, may be produced by a fault in the suspension. If a pendulum be suspended by a wire passing through a hole in a solid plate of metal, the orifice of that hole may be oval. If the wire be part of a thicker rod tapering to the size of the wire, it may taper unequally on different sides. In either case, there will be two planes of vibration, at right angles to each other, in which, if the pendulum is vibrating, it will continue to vibrate, and in one of which the time of vibration is greater, and in the other less, than in any other plane; and, the amplitude of vibration being very small, the complete motion may be found by compounding the vibrations corresponding to these two planes."

After investigating the effect of these causes of error, the Astronomer Royal arrives at the following conclusion:—"It appears, therefore, that the effect of faulty suspension may be sensibly eliminated between two experiments in which the azimuths of the first vibration differ by 45°; and it may be prudent, in making any important experiment, thus to change the commencement-azimuth in successive trials."

Some Views respecting the Source of Light, &c.

By James Nasmyth, Esq., F.R.A.S.

"Impressed with the conviction that the progress of science has often been most importantly advanced by the setting forth of hypothetical views as to the nature of those causes which result in great phenomena, I am, for these reasons, induced to hazard and venture forth with some views on the subject of the nature of solar light, more especially in reference to the well-known but most remarkable phenomena, occurring in the case of stars of variable and transitory brightness, as also in reference to those wonderful results of geological research, namely, the unquestionable evidence of the existence of an arctic or glacial climate in regions where such cannot now naturally exist; thus giving evidence of the existence of a condition of climate, for the explanation of which we look in vain to any, at present, known cause.

"I must plead the fact of the existence of such wonderful phenomena as these alluded to as my apology for thus attempting to come forth with what, although they may appear crude, theoretical notions, yet may, as tending to direct increased attention to important phenomena, so lead in due time to the developement of truth, and extend the present bounds of our knowledge of those mighty laws which are so mysteriously indicated by the existence of the phenomena in question, and with the evidences of which we are yet surrounded.

"A course of observations on the solar spots, and on the remarkable features which from time to time appear on the sun's surface, which I have examined with considerable assiduity for several years, had in the first place led me to entertain the following conclusion; namely, that whatever be the nature of solar light, its main source appears to result from an action induced on the *exterior surface* of the solar sphere,—a conclusion in which I doubt not all who have attentively pursued observations on the structure of the sun's surface will agree.

"Impressed with the correctness of this conclusion, I was led to consider whether we might not reasonably consider the true source of the latent element of light to reside, *not in the solar orb*, but in space itself; and that the grand function and duty of the sun was to act as an agent for the bringing forth into vivid existence its due portion of the illuminating or luciferous element, which element I suppose to be diffused throughout the boundless regions of space, and which in that case must be perfectly exhaustless.

"Assuming, therefore, that the sun's light is the result of some peculiar action by which it brings forth into *visible* existence the element of light, which I conceive to be latent in, and diffused throughout, space, we have but to imagine the existence of a very probable condition, namely, the *unequal* diffusion of this light-yielding element, to catch a glimpse of a reason why our sun may, in common with his solar brotherhood, in some portions of his vast

stellar orbit, have passed, and may yet have to pass, through regions of space, in which the light-yielding element may either abound or be deficient, and so cause him to beam forth with increased splendour, or fade in brilliancy, just in proportion to the richness or poverty of this supposed light-yielding element as may occur in those regions of space through which our sun, in common with every stellar orb, has passed, is now passing, or is destined to pass, in following up their mighty orbits.

"Once admit that this light-yielding element resides in *space*, and that it is *not* equally diffused, we may then catch a glimpse of the cause of the variable and transitory brightness of stars, and more especially of those which have been known to beam forth with such extraordinary splendour, and have again so mysteriously faded away; many instances of which abound in historical record.

"Finally, in reference to such a state of change having come over our sun, as indicated by the existence of a glacial period, as is now placed beyond doubt by geological research, it appears to me no very wild stretch of analogy to suppose that in such former periods of the earth's history our sun may have passed through portions of his stellar orbit in which the light-yielding element was deficient, and in which case his brilliancy would have suffered the while, and an arctic climate in consequence spread from the poles towards the equator, and leave the record of such a condition in glacial handwriting on the everlasting walls of our mountain ravines, of which there is such abundant and unquestionable evidence. As before said, it is the existence of such facts as we have in stars of transitory brightness, and the above-named evidence of an arctic climate existing in what are now genial climates, that renders some adequate cause to be looked for. I have accordingly hazarded the preceding remarks as suggestive of a cause, in the hope that the subject may receive that attention which its deep interest entitles it to obtain.

"This view of the source of light, as respects the existence of the luciferous element throughout space, accords with the Mosaic account of creation, in so far as that light is described as having been created in the first instance *before the sun* was called forth."

Note by the Astronomer Royal.

"In an oral address to the Society, on 1849, December 14, an abstract of which is printed in the *Monthly Notices*, vol. x. No. 2, in describing the method of recording transits by the agency of a galvanic current, I ascribed certain steps of the invention to Dr. Locke and Professor Mitchell. I have lately been informed that the invention was also shared by Mr. Bond, Mr. Walker, and perhaps by other persons. I am desirous of explaining to the Society that the history, such as I gave it at that time, was founded upon the printed papers which had then reached me, and upon my correspondence with American friends; both necessarily im-

perfect sources of information; and that I had no wish to assert the claims of Messrs. Locke and Mitchell further than as they seemed to be implied in those documents, nor to express any opinion on the claims of others, either to the first idea or to the subsequent steps of the invention."

Description of the Apparatus for observing Transits, by means of a Galvanic Current, now used at the Observatory of Cambridge, U.S. By Mr. G. P. Bond.*

The apparatus exhibited to the Society, is the same which has been for some time past in use at the Harvard Observatory, U.S., and is the property of the United States Coast Survey. It consists of an electric break-circuit clock, a galvanic battery of a single Grove's cup, and the spring governor, by which a uniform motion is given to the cylinder carrying the paper.

The electric clock is of the form proposed by Mr. Bond. Though different in its object and construction, the effect produced is the same with that of the clock proposed by Professor Wheatstone, namely, the interruption of the galvanic circuit at intervals of a second. The pallets and the escapement-wheel are insulated, both from the pendulum and from the other wheels. When the battery is in connexion, the circuit is broken by the pallet leaving the tooth of the wheel, and is restored at the instant of the beat of the clock, which is in fact the sound produced by the completion of the contact restoring the circuit: the passage of the current being through the pallet and the escapement-wheel alone. With the exception of the connecting wires, and the insulation of some parts, the clock is like those in common use for astronomical purposes.

Two wires pass from the clock, one direct to the battery, and the other, through the break-circuit-key used by the observer, and through the recording magnet, back to the battery. The length of wire is of course immaterial.

The magnet, with a slight difference in the form of the armature, is the same with those used on Morse's telegraph lines in the United States. The armature carries a glass pen, supplied with ink from a small reservoir. Under this pen the paper revolves on which the records are made. The breaking of the circuit by the clock, every second, is marked by an offset made by the pen, and the breaking of the circuit by the observer, is similarly recorded between the second marks of the clock. The paper is wound upon a cylinder, as suggested by Mr. Saxton of Washington. Unless a motion perfectly uniform is given to the cylinder, the second marks at the end of an hour, instead of being arranged in regular straight lines upon the paper, will change their relative positions, and the record become so confused as to make it a most serious undertaking to read off the observations after they have been taken.

* This is the substance of a lecture delivered by Mr. Bond, in which the whole *modus operandi* was clearly shown.

To give a uniform motion to this cylinder has been the chief obstacle in the way of the application of electro-magnetism to practical astronomy, so that it should be of general utility; for although very rude contrivances will illustrate the process, and even afford accurate results, the time required to interpret the record may be greater than that required to make the observations throughout by the old method, and the liability to errors in the minutes and seconds is increased. A saving in the quantity of recording surface was also requisite.

The apparatus invented at Cambridge for this object is called the spring governor. The train of wheels which communicates the motive power to the cylinder connects with a small fly-wheel. This fly is for supplying momentum, and holds no part in the regulation. Beyond this fly, reckoning from the cylinder, is a half-seconds pendulum, with a dead-beat escapement. The connexion between the escapement-wheel and the fly is through a short spring. The elasticity of this spring allows the motion of the escapement-wheel to be completely arrested at each vibration of the pendulum, while the momentum of the fly, acting for a small fraction of a second only on the spring, keeps up the motion of the cylinder. The machinery is thus completely under the control of the pendulum. No accumulation of irregularity can take place beyond the limits of the bending and unbending of the connecting spring. After this is adjusted to its minimum, the continuous rotary motion will be performed with all the accuracy of the beats of the pendulum for any length of time. It is, in fact, a complete solution of the difficulty of producing exact uniform motion. An advantageous application of the same principle might be made to the clock-work for the equatoreal motion of telescopes.

The cylinder makes a single rotation in a minute. The second marks and the observations succeed each other in a continuous spiral. When a sheet is filled, and it is taken from the cylinder, the second marks and observations appear in parallel columns, as in a table of double entry, the minutes and seconds being the two arguments at the head and side of the sheet.

The observer, with the break-circuit-key in his hand or at his side, at the instant of the transit of a star over the wire of a telescope, touches the key with his finger. The record is made at the same instant on the paper. The operation may be repeated easily, at intervals between the successive transits, of one or two seconds each.

The experience we have now had places beyond doubt the fact that, for convenience and accuracy of individual results, this new mode of observing is in advance of the old. The number of comparisons for differences of right ascension may be increased to an extent which distinguishes it, equally with its superior accuracy, as a real improvement in the science of practical astronomy. The extension of the method to the registration of differences of declination, simultaneously with differences of right ascension, promises great facility in taking zones of small stars.

Owing to the difficulty of obtaining precise information respecting scientific matters in America, considerable inaccuracies have crept into the *historical* part of the lecture given by the Astronomer Royal on the American method of observing by the electro-magnetic circuit (*Monthly Notices*, Dec. 1849). The preceding note from the Astronomer Royal will prevent misconception on this point. But, setting aside the claims of individuals in this matter, so far as this is an American discovery, it is only under the auspices of the Department of the Coast Survey of the United States, and with the facilities and means furnished by its present enlightened superintendent, Dr. A. D. Bache, that the application of electro-magnetism to the purposes of geodesy and of astronomy has been successfully accomplished.

Daguerreotypes of the moon were exhibited to the members present, taken by Messrs. Whipple and Jones, of Boston, from the image formed in the focus of the great equatoreal of the Harvard Observatory.

Extract of a Letter from Mr. Lassell.

"I have been very busy, and have brought to a most successful issue my efforts to support my two-foot speculum free from sensible flexure. All has gone on well and come right at once; and the speculum having been once placed in the tube, I have neither reason nor inclination to take it out again. I was pretty sanguine, yet must acknowledge the result has gone beyond my hopes. I announced the details of the plan to the British Association at Edinburgh,* and there is a clear and sufficient description of it in the Report just about publishing, or perhaps already out. I have scarcely varied at all in carrying it out. I have found 27 or 28 levers sufficient; and these are about as many as can be conveniently applied without interfering with the 18 discs and levers for zenithal support. Moreover, I have found cementing fulcral blocks of speculum metal upon the back with plaster of Paris quite efficient—firm enough to bear twice the requisite strain. Each lever, in a horizontal position of the tube, supports 15 lbs. of the speculum's weight; diminishing, of course, as the telescope approaches the zenith, where they are inactive. The superiority of action of the telescope since the application of this apparatus, I think none but myself who have seen it in both states can yet appreciate, and the atmosphere now alone remains my formidable and unconquerable foe, as it is indeed of all large apertures. So tenderly is the metal sustained in all positions, that no part of it can ever come into contact, with more than the pressure of a few pounds, against the tube or box in which it

* *Reports of the Twentieth Meeting of the British Association*, 1850; *Notices and Abstracts*, p. 180, &c. On a method of supporting a large speculum, free from sensible flexure, by Mr. Lassell, &c.

is placed. The plan seems to me applicable to specula of two or three times the diameter of mine with equal success. I was scarcely prepared to believe beforehand that the bending would follow so regular a law, as that it should be completely eliminated by a regularly devised system of counteracting support. I believe the application of the apparatus does not add more than 40 lbs. to that end of the tube which contains the speculum.

"Did I mention to you that I had (some time ago now) made an addition and improvement to the polishing machine by communicating a regular slow motion to the polisher? It has given me some trouble and looks complex, but it is efficient, and tends, I think, to greater uniformity of curve. But when I have leisure, I must describe it more fully."

Extract of a Letter from M. Johnson, Esq., Director of the Radcliffe Observatory, Oxford.

"You will be glad to hear that the Radcliffe Trustees have sanctioned the appointment of a second assistant at this observatory. Besides this important addition, the Trustees allow me a journeyman to look after the meteorological department, *i.e.* to prepare the photographic paper, &c., and I am also granted a certain sum for additional computations; altogether, this observatory is now as well set up as it need be.

"My first course will be to direct our attention to completing the catalogue of the northern stars. All our annual catalogues, except 1842, are already brought up to our proposed epoch, 1845; and in a few months all the recognisable stars of Groombridge's catalogue will have been observed. We shall then have to arrange the work, to get out the precessions, and to amend the places of some stars near the pole (not the very close stars), which have been necessarily brought up with slightly inaccurate precessions. In thinking over the form of the catalogue, my present idea is to give every *datum* necessary for the future revision of our places; for though I hope to escape with very few mistakes, I cannot expect to avoid them altogether. This will swell the publication considerably, and the recomputation of all the constants to fit the new places is rather a formidable work. I feel, however, very well disposed to face this; and I trust by a suitable index to supply future observers with the means of verifying any of our places with but little trouble."

Occultation of a Fixed Star by Jupiter.
By the Rev. W. R. Dawes.

1851, May 8, 9^h G.M.T. Having turned my $8\frac{1}{2}$-foot refractor upon *Jupiter*, I instantly perceived a small star near his western edge, and observed its occultation with power 188. The disap-

pearance occurred at $9^h\ 20^m\ 48^s \pm$ G.M.T.; the angle on the limb, measured from the planet's northern pole round by the eastern or following side, being about 250°. *Jupiter* was obscured by clouds at the time of the reappearance of the star, which is Bessel (Weisse) xii, 966. Mean place for 1825, R.A. $12^h\ 54^m\ 49^s{\cdot}21$, $\delta - 4°\ 12'\ 33''{\cdot}2$. It is of the 8th magnitude, according to Bessel.

The air was unfavourable, and the time noted is therefore uncertain to a few seconds.

Micrometrical Measures of γ Virginis. By Isaac Fletcher, F.R.A.S.

"The binary star *γ Virginis*, being an object of extraordinary interest, I beg leave to submit the following measures of its angle of position and distance to the Royal Astronomical Society.

"The measures were taken with extreme care with the six-foot equatoreal and clock motion, and parallel wire-micrometer.

Epoch.	Position.	Weight.	Distance.	Weight.
	° ′		″	
1851·386	176 16	3	3·011	3
·397	175 55	2	3·005	4
·400	175 29	4	3·035	4
·402	176 2	3	3·107	2
·408	176 20	4	3·088	4
·408	175 51	4	3·056	4
Mean 1851·401	175 58	20	3·047	21

"In taking the mean, the several proportional weights are duly allowed for. Each set consists of eight measures of position, and eight double measures of distance."

On the evening of March 12, 1851, as the sun was setting in the midst of a thick haze, Mr. Weld observed a spot on the sun's disc with the naked eye. On pointing it out to one or two other persons, they saw it with facility. Next day he observed the sun with the equatoreal, and found a single large spot nearly round but somewhat angular. Its greatest measured diameter parallel to the equator was $4^s{\cdot}05$, that of the nucleus $1^s{\cdot}60$. Its diameter measured along the meridian circle was $52''{\cdot}53$.

Astronomische Nachrichten.

The Editor of the *Monthly Notices* has received from Mr. J. Schumacher an account of the stock in hand of the lamented Professor's publications, including a complete list of the back Volumes and Numbers of the *Nachrichten.* In the June *Notice*

he hopes to give a fuller account; but in the mean time he would recommend those gentlemen who possess *incomplete* copies of this invaluable work to send lists of the Volumes and Numbers which they require, and he will try to supply them, without unnecessary cost, on the principle of serving first the first applicant.

ERRATA.

R.A. of Weisse xxi, 937, is 1^m in defect.
Astron. Nachrichten, No. 760, Berlin Observations of *Irene*, *for* May 14 and 16, *read* 24 and 26.

☞ *Owing to the absence of the Editor, and two or three unlucky coincidences, Number 7 went to press in a less correct state than was desirable. A few copies only were taken off and distributed; it has been thought advisable to cancel this first impression and to reprint the whole in the present more perfect form.*

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